Gulf of Alaska Play 2: Yakataga Fold and Thrust Belt Play

Geological Assessment

GRASP UAI: AAAAA EAC
Play Area: 2,000 square miles
Play Water Depth Range: 180-720 feet
Play Depth Range: 6,200-16,000 feet
Play Exploration Chance: 0.174

Play 2, Yakataga Fold and Thrust Belt, Gulf of Alaska OCS Planning Area, 2006 Assessment, Undiscovered Technically-Recoverable Oil & Gas

Assessment Results as of November 2005

Resource Commodity (Units)	Resources *		
	F95	Mean	F05
BOE (Mmboe)	0	258	961
Total Gas (Tcfg)	0.000	0.760	2.894
Total Liquids (Mmbo)	0	122	446
Free Gas** (Tcfg)	0.000	0.651	2.496
Solution Gas (Tcfg)	0.000	0.109	0.398
Oil (Mmbo)	0	88	317
Condensate (Mmbc)	0	34	129

** Risked, Technically-Recoverable*

*** Free Gas Includes Gas Cap and Non-Associated Gas*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Mmb = millions of barrels

Tcf = trillions of cubic feet

Table 1

Play 2, the "Yakataga Fold and Thrust Belt" play, is the second most important (of six plays) in the Gulf of Alaska OCS Planning Area, with 18% (258 Mmboe) of the Planning Area energy endowment (1,454 Mmboe). The overall assessment results for play 2 are shown in table 1. Oil and gas-condensate liquids form 47% of the hydrocarbon energy endowment of play 2. Table 5 reports the detailed assessment results by commodity for play 2.

Table 3 summarizes the volumetric input data developed for the *GRASP* computer model of Gulf of Alaska play 2. Table 4 reports the risk model used for play 2. The location of play 2 is shown in figure 1.

Play 2 extends east from the Kayak zone to the Pamplona zone. Potential traps are primarily the large and widespread fault-bounded anticlines of Pliocene and younger age, with some stratigraphic traps possibly formed adjacent to the structures. The most prospective reservoir objectives within drillable depths are sandstones of the Yakataga Formation (particularly the lower part) of Late Miocene to Pleistocene age. Also, locally-developed reservoir-quality sandstones may occur in the upper part of the Poul Creek Formation of Late Eocene to Middle Miocene age.

Two potential source rock sequences have been identified for play 2: 1) Eocene rocks of the nonmarine to deltaic Kulthieth Formation and its deeper marine equivalent facies; and 2) middle to upper Miocene rocks of the upper Poul Creek Formation. Oil has been encountered at several onshore seeps and well sites, including the oil at Katalla field. However, the organically richest potential source, the Miocene Poul Creek Formation, is thermally immature where encountered in offshore wells. Potential source rocks of Eocene age are mature offshore only where very deeply buried. Ten exploratory wells tested several of the larger structures in this play and failed to discover recoverable hydrocarbons.

Play 2, Yakataga Fold and Thrust Belt, Gulf of Alaska OCS Planning Area, 2006 Assessment, Conditional BOE Sizes of Ten Largest Pools			
Assessment Results as of November 2005			
Pool Rank	BOE Resources *		
	F95	Mean	F05
1	26	282	929
2	10	88	257
3	5.1	47	133
4	3.2	30	84
5	2.3	21	59
6	1.8	16	44
7	1.5	13	35
8	1.3	10	29
9	1.2	9	25
10	1.1	8	21

** Conditional, Technically-Recoverable, Millions of Barrels Energy-Equivalent (Mmboe), from "PSRK.out" file*

F95 = 95% chance that resources will equal or exceed the given quantity

F05 = 5% chance that resources will equal or exceed the given quantity

BOE = total hydrocarbon energy, expressed in barrels-of-oil-equivalent, where 1 barrel of oil = 5,620 cubic feet of natural gas

Table 2

A maximum of 25 hypothetical pools is forecast by the aggregation of the risk model and the prospect numbers model for play 2. These 25 pools range in mean conditional (un-risked) recoverable volumes from 2 Mmboe (pool rank 25) to 282 Mmboe (pool rank 1). Pool rank 1 ranges in possible conditional recoverable volumes from 26 Mmboe (F95) to 929 Mmboe (F05), or in a gas case from 0.146 Tcfge (F95) to 5.221 Tcfge (F05). Table 2 shows the conditional sizes of the 10 largest pools in play 2.

In the computer simulation for play 2 a total of 35,272 “simulation pools” were sampled for size. These simulation pools can be grouped according to the USGS size class system in which sizes double with each successive class. Pool size class 10 contains the largest share (6,897, or 20%) of simulation pools (conditional, technically recoverable BOE resources) for play 2. Pool size class 10 ranges from 16 to 32 Mmboe.

The largest simulation pool for play 2 falls within pool size class 18, which ranges in size from 4,096 to 8,192 Mmboe (or 23 to 46 Tcfge). Table 6 reports statistics for the simulation pools developed in the *GRASP* computer model for play 2.

GRASP Play Data Form (Minerals Management Service - Alaska Regional Office)

Gulf of Alaska
Play Number: 2
Play UAI Number: AAAAAEAC

Assessor: Comer / Larson
Play Name: Yakataga Fold & Thrust Belt

Date: March, 2005

Play Area ($mi^{2)}$ millions of acres): 2,000 mi^2, 1.28 million acres
Reservoir Thermal Maturity, % Ro: 0.4+ - 0.6

Play Depth Range, feet: 6,200 - 9,800 - 16,000
Expected Oil Gravity, ^{O} API: 35
Play Water Depth Range, feet: 180 - 360 - 720
Prospect Distance from shore, miles: 6 - 17 - 40

POOLS Module (Volumes of Pools, Acre-Feet)

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Prospect Area (acres)-Model Input	0				5250	~~~					39000		~
Prospect Area (acres)-Model Output	100	1054	1502	2717	5250	8456.5 / 10678.4	10143	14443	18349	26162	39000	50893	75000
Fill Fraction (Fraction of Area Filled)	0.08	0.158	0.182	0.23	0.3	0.32386 / 0.13171	0.391	0.45	0.495	0.571	0.67	0.745	0.94
Productive Area of Pool (acres)	26	260	389	762	1610	3036.76 / 4576.90	3401	5081	6668	9976	15700	21241	62800
Pay Thickness (feet)	5	28	37	59	100	137.301/ 131.204	170	225	273	363	500	619	1844

MPRO Module (Numbers of Pools)

Play Level Chance	0.6	Prospect Level Chance	0.29	Exploration Chance	0.174

Risk Model	Play Chance	Petroleum System Factors	Prospect Chance
		[See Risking Sheet]	

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Numbers of Prospects in Play	7	12	13	16	19	20.27 / 5.69	23	25	27	30	34	36	54
Numbers of Pools in Play	~	~	F59.79 = 0	F55 = 3	3	3.53 / 3.53	6	7	8	10	11	12	25

Minimum Number of Pools	0	Mean Number of Pools	3.53	Maximum Number of Pools	25

POOLS/PSRK/PSUM Module (Play Resources)

Fractile	F100	F95	F90	F75	F50	Mean / Std. Dev.	F25	F15	F10	F05	F02	F01	F00
Oil Recovery Factor (bbl/acre-foot)	32	72	84	106	139	150.647 / 63.377	182	210	231	267	314	350	609
Gas Recovery Factor (Mcfg/acre-foot)	88	266	324	449	646	749.497 / 444.592	929	1129	1288	1566	1952	2260	4770
Gas Oil Ratio (Sol'n Gas)(cf/bbl)	470	747	828	983	1190	1238.812 / 360.741	1440	1596	1710	1896	2128	2299	2850
Condensate Yield ((bbl/Mmcfg)	20	40	42	47	52	52.646 / 8.460	58	61	64	67	72	75	100

Pool Size Distribution Statistics from *POOLS* (1,000 BOE): **μ (mu) =** 10.1946038 **σ^2 (sigma squared) =** 2.00922285 **Random Number Generator Seed =** 965932

BOE Conversion Factor (cf/bbl)	5620	Probability Any Pool Contains Both Oil and Free Gas (Gas Cap)	1
Probability Any Pool is 100% Oil	0	Fraction of Pool Volume Gas-Bearing in Oil Pools with Gas Cap	0.6
Probability Any Pool is 100% Gas	0		

Table 3. Input data for Gulf of Alaska play 2, 2006 assessment.

Risk Analysis Form - 2005 National Assessment

Assessment Province:	Gulf of Alaska	**Play Number, Name:**	2, Yakataga Fold & Thrust Belt
Assessor(s):	Comer & Larson	**Play UAI:**	AAAAAEAC
Date:	13-Oct-05		

For each component, a *quantitative* probability of success (i.e., between zero and one, where zero indicates no confidence and one indicates absolute certainty) based on consideration of the *qualitative* assessment of **ALL** elements within the component was assigned. This is the assessment of the probability that the minimum geologic parameter assumptions have been met or exceeded.

			Play Chance Factors	Averge Conditional Prospect Chance[1]
1.	**Hydrocarbon Fill component** (1a * 1b * 1c)	**1**	***0.7500***	***0.5600***
	a. Presence of a Quality, Effective, Mature Source Rock			
	Probability of efficient source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the reservoirs.	1a	1.00	0.80
	b. Effective Expulsion and Migration			
	Probability of effective expulsion and migration of hydrocarbons from the source rock to the reservoirs.	1b	0.75	1.00
	c. Preservation			
	Probability of effective retention of hydrocarbons in the prospects after accumulation.	1c	1.00	0.70
2.	**Reservoir component** (2a * 2b)	**2**	***0.8000***	***0.8000***
	a. Presence of reservoir facies			
	Probability of presence of reservoir facies with a minimum net thickness and net/gross ratio (as specified in the resource assessment).	2a	0.80	1.00
	b. Reservoir quality			
	Probability of effectiveness of the reservoir, with respect to minimum effective porosity, and permeability (as specified in the resource assessment).	2b	1.00	0.80
3.	**Trap component** (3a * 3b)	**3**	***1.0000***	***0.6500***
	a. Presence of trap			
	Probability of presence of the trap with a minimum rock volume (as specified in the resource assessment).	3a	1.00	0.65
	b. Effective seal mechanism			
	Probability of effective seal mechanism for the trap.	3b	1.00	1.00

Overall Play Chance (Marginal Probability of hydrocarbons, MPhc)	***0.6000***	
(1 * 2 * 3) *Product of All Subjective Play Chance Factors*		
Average Conditional Prospect Chance[1]		***0.2912***
(1 * 2 * 3) *Product of All Subjective Conditional Prospect Chance Factors*		
[1] Assumes that the Play exists (where all play chance factors = 1.0)		
Must be consistent with play chance and prospect distribution -- See discussion on Page 3 of Guide		
Exploration Chance	***0.1747***	
(Product of Overall Play Chance and Average Conditional Prospect Chance)		

Comments: *See guidance document for explanation of the Risk Analysis Form*

Table 4. Risk model for Gulf of Alaska play 2, 2006 assessment.

GRASP - Geologic and Economic Resource Assessment Model - PSUM Module Results

Minerals Management Service - Alaska OCS Region
GRASP Model Version: 8.29.2005)
Computes the Geologic Resource Potential of the Play

Play UAI:	**AAAAAEAC**		**Play No.**		**2**		
World	Level	-	World	Level	Resources		
Country	Level	-	UNITED	STATES	OF	AMERICA	
Region	Level	-	MMS	-	ALASKA	REGION	
Basin	Level	-	**GULF**	**OF**	**ALASKA**		
Play	**Level**	**-**	**Play**		**2**	**Yakataga Fold and Thrust Belt**	
Geologist	Larson,	Comer					
Remarks	Play		2 Yakataga				
Run Date & Time:		Date	19-Sep-05	Time	14:02:57		

Summary of Play Potential

Product	MEAN	Standard Deviation
BOE (Mboe)	257,630	423,860
Oil (Mbo)	88,094	149,120
Condensate (Mbc)	34,358	59,773
Free (Gas Cap & Nonassociated) Gas (Mmcfg)	650,520	1,110,900
Solution Gas (Mmcfg)	109,180	190,660

10000 (Number of Trials in Sample)
0.5977 (MPhc [Probability] of First Occurrence of Non-Zero Resource)
Windowing Feature: used

Empirical Probability Distributions of the Products

Greater Than Percentage	BOE (Mboe)	Oil (Mbo)	Condensate (Mbc)	Free (Gas Cap & Nonassociated) Gas (Mmcfg)	Solution Gas (Mmcfg)
100	0	0	0	0	0
99.99	0	0	0	0	0
99	0	0	0	0	0
95	0	0	0	0	0
90	0	0	0	0	0
85	0	0	0	0	0
80	0	0	0	0	0
75	0	0	0	0	0
70	0	0	0	0	0
65	0	0	0	0	0
60	1,539	614	179	3,441	754
55	64,494	22,731	8,362	159,890	27,828
50	108,160	39,083	13,728	262,850	48,221
45	152,600	52,958	20,533	377,510	67,089
40	198,050	69,269	25,480	495,210	85,342
35	245,890	86,744	32,076	609,320	104,830
30	298,930	108,160	37,900	725,830	133,310
25	365,700	134,940	46,207	874,250	162,930
20	444,490	156,150	58,199	1,099,800	193,620
15	545,030	179,440	74,358	1,411,200	225,490
10	695,010	238,420	92,771	1,748,600	296,100
8	779,480	267,890	104,040	1,959,200	331,220
6	888,150	298,590	118,980	2,282,300	362,380
5	960,970	316,830	129,120	2,496,100	398,270
4	1,050,000	341,390	145,500	2,751,400	413,530
2	1,458,000	487,490	194,450	3,755,100	606,550
1	1,934,700	617,210	271,840	5,082,600	793,730
0.1	4,077,100	1,503,500	525,490	9,608,500	1,901,600
0.01	7,405,200	1,959,600	1,117,600	22,769,000	1,553,900
0.001	8,476,600	2,077,100	1,398,700	25,459,000	2,645,400

Table 5. Assessment results by commodity for Gulf of Alaska play 2, 2006 assessment.

Basin: GULF OF ALASKA
Play 02 - Yakataga Fold and Thrust Belt
UAI Key: AAAAAEAC

Model Simulation "Pools" Reported by "Fieldsize.out" *GRASP* Module

Classification and Size				Pool Count Statistics				Pool Types Count			Mixed Pool Range		Oil Pool Range		Gas Pool Range		Total Pool Range			Pool Resource Statistics (MMBOE)			
Class	Min (MMBOE)	Max (MMBOE)	Pool Count	Percentage	Trial Average	Trials w/Pool Avg		Mixed Pool	Oil Pool	Gas Pool	Min	Max	Min	Max	Min	Max	Min	Max		Min	Max	Total Resource	Average Resource
1	0.0312	0.0625	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
2	0.0625	0.125	3	0.008505	0.0003	0.000502		3	0	0	1	1	0	0	0	0	1	1		0.089900	0.101247	0.287278	95.759250
3	0.125	0.25	14	0.039692	0.0014	0.002342		14	0	0	1	1	0	0	0	0	1	1		0.141348	0.249699	2.870924	205.065966
4	0.25	0.5	63	0.178612	0.0063	0.010539		63	0	0	1	1	0	0	0	0	1	1		0.253545	0.484806	24.136849	383.124590
5	0.5	1	278	0.788161	0.0278	0.046504		278	0	0	1	3	0	0	0	0	1	3		0.507918	0.999851	216.779273	779.781580
6	1	2	805	2.282264	0.0805	0.13466		805	0	0	1	3	0	0	0	0	1	3		1.001127	1.999504	1225.280000	1.522087
7	2	4	1919	5.440576	0.1919	0.32101		1919	0	0	1	4	0	0	0	0	1	4		2.001188	3.999218	5747.499000	2.995049
8	4	8	3698	10.484237	0.3698	0.618602		3698	0	0	1	5	0	0	0	0	1	5		4.003076	7.996911	21885.595000	5.918225
9	8	16	5805	16.457813	0.5805	0.971061		5805	0	0	1	6	0	0	0	0	1	6		8.000012	15.999735	67922.314000	11.700657
10	16	32	6897	19.553753	0.6897	1.15373		6897	0	0	1	7	0	0	0	0	1	7		16.000964	31.996209	158999.483000	23.053427
11	32	64	6375	18.073826	0.6375	1.06641		6375	0	0	1	7	0	0	0	0	1	7		32.002613	63.966529	291524.868000	45.729389
12	64	128	4713	13.361874	0.4713	0.788391		4713	0	0	1	7	0	0	0	0	1	7		64.008415	127.990599	426009.958000	90.390404
13	128	256	2763	7.833409	0.2763	0.462195		2763	0	0	1	4	0	0	0	0	1	4		128.123787	255.973416	495364.183000	179.284897
14	256	512	1311	3.716829	0.1311	0.219304		1311	0	0	1	3	0	0	0	0	1	3		256.238816	510.076646	462828.044000	353.034363
15	512	1024	430	1.219097	0.043	0.07193		430	0	0	1	2	0	0	0	0	1	2		512.666963	1021.531000	297403.623000	691.636353
16	1024	2048	157	0.445112	0.0157	0.026263		157	0	0	1	2	0	0	0	0	1	2		1025.504000	2028.746000	219310.874000	1.396885
17	2048	4096	36	0.102064	0.0036	0.006022		36	0	0	1	2	0	0	0	0	1	2		2056.756000	4012.661000	97421.151000	2.706143
18	4096	8192	5	0.014176	0.0005	0.000836		5	0	0	1	1	0	0	0	0	1	1		4403.443000	7888.864000	30414.834000	6.082967
19	8192	16384	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
20	16384	32768	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
21	32768	65536	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
22	65536	131072	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
23	131072	262144	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
24	262144	524288	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
25	524288	1048576	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0		0.000000	0.000000	0.000000	0.000000
Not Classified			0	0	0	0	Below Class	0	0	0									Below Class	0.000000	0.000000	0.000000	0.000000
		Totals	**35272**	**100.000008**	**3.5272**	**5.900301**	Above Class	0	0	0									Above Class	0.000000	0.000000	0.000000	0.000000

Number of Pools not Classified: 0
Number of Pools below Class 1: 0
Number of Trials with Pools: 5978

Min and Max refer to numbers of pools of the relevant size class that occur within any single trial in the simulation.

Min and Max refer to aggregate resources of the relevant size class that occur within any single trial in the simulation.

Table 6. Statistics for simulation pools created in computer sampling run for Gulf of Alaska play 2, 2006 assessment.

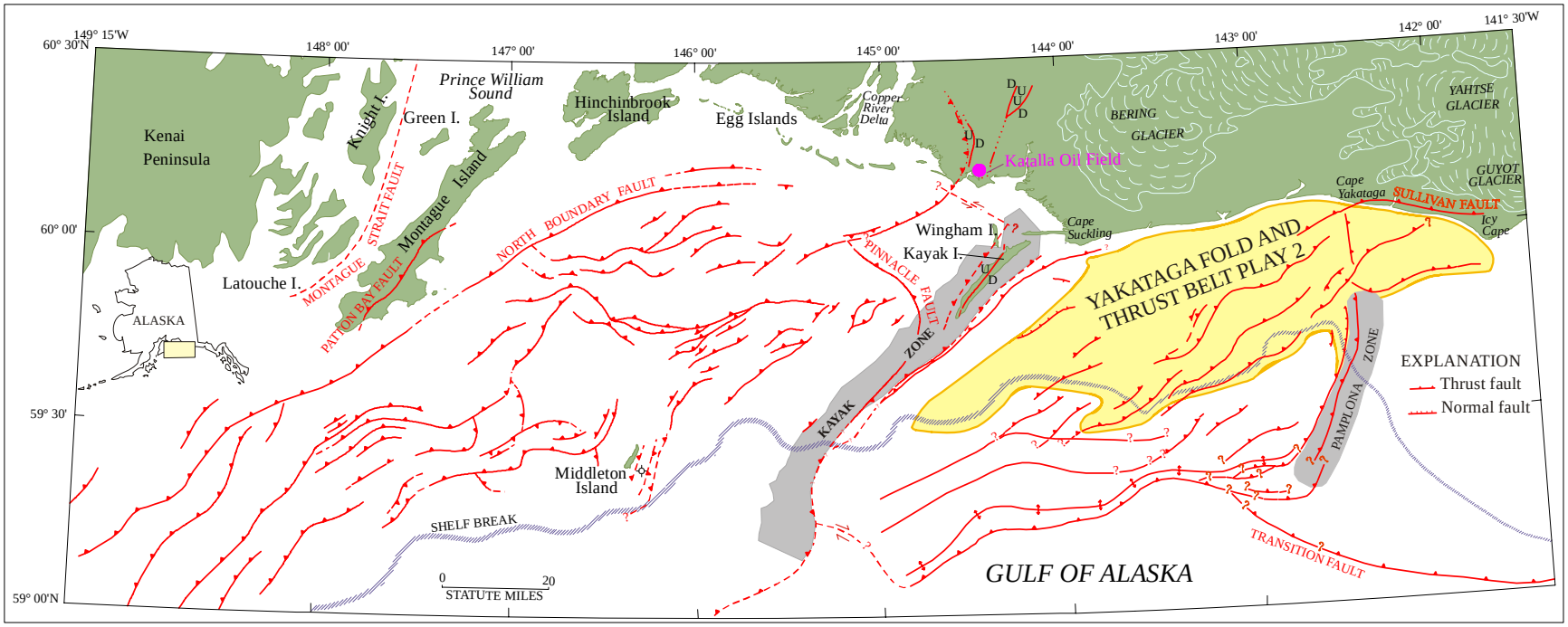

Figure 1. Map location of Gulf of Alaska play 2, 2006 assessment.